

REPPERGER RESEARCH INTERN PROGRAM

RESEARCH PROJECT #: AFRL-RHD-23-05

Fractional Order Biophysics

PROJECT DESCRIPTION: Research has shown that biophysical processes, such as laser-tissue interaction, deviate from the predictions given by traditional mathematical models for short laser exposure times. In general, it was found that the shorter the exposure time is, the stronger the deviation will be. Standard models provide a macroscopic description of heat transfer, but some research suggests that microscopic interactions should be considered for accurate temperature predictions. Alternative methods are being formulated in an attempt to describe these phenomena from a first principles point of view. The purpose of this project is to analyze and apply an appropriate mathematical formulation that accounts for the deviations from established theory and can make accurate predictions for dynamic systems, such as biological tissue. Methods will include both analytical and/or numerical approaches for solving quasi-linear (parabolic, elliptic, and hyperbolic) partial differential equations with various boundary conditions, analyzing correlation between various parameters of interest, and possibly considering other non-standard equations. Other objectives include rigorous problem and solution definition in meta-language forms to enable language-agnostic solvers and development of numerical toolboxes for solving the problems in high-performance computing environments.

ACADEMIC LEVEL: Bachelor's, Master's, PhD

DISCIPLINE NEEDED:

- Mathematics
- Biomedical Engineering
- Physics

RESEARCH LOCATION: JBSA-Fort Sam Houston, San Antonio, Texas

RESEARCH MENTOR: Andrew Wharmby, PhD
Biomedical Engineering, University of Texas, San Antonio, 2013



Andrew Wharmby is a biomedical engineer in the Airman Systems Directorate. He joined the Air Force Research Laboratory in 2006 and now focuses on applied mathematics, computational physics, and the application of fractional calculus to solve problems involving biomedical optics and bioelectromagnetics.

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